

## NASAL IRRIGATION – HIGHLIGHTED BIBLIOGRAPHY

**Clinical Guidelines on Chronic Rhinosinusitis in Children.** Chandy, Z., E. Ference and J. T. Lee. *Curr Allergy Asthma Rep* 19, no. 2 (2019): 14.

This review provides an overview of the current guidelines and recent literature regarding the diagnosis, microbiology, and treatment options of chronic rhinosinusitis in the pediatric population. Nasal saline irrigation is recommended as a first-line treatment option, well supported in current literature.

**\*Clinical Practice Guideline (Update): Adult Sinusitis.** Rosenfeld, R. M., J. F. Piccirillo, S. S. Chandrasekhar, I. Brook, K. Ashok Kumar, M. Kramper, R. R. Orlandi, J. N. Palmer, Z. M. Patel, A. Peters, S. A. Walsh and M. D. Corrigan. *Otolaryngol Head Neck Surg* 152, no. 2 Suppl (2015): S1-S39.

Updated guideline that provides evidence-based recommendations to manage adult rhinosinusitis. Among others, the update group made *recommendations*, including that clinicians should suggest saline nasal irrigation, topical intranasal corticosteroids, or both for symptom relief of chronic rhinosinusitis.

**BSACI guidelines for the management of rhinosinusitis and nasal polyposis** G. K. Scadding, S. R. Durham, R. Mirakian, N. S. Jones, A. B. Drake-Lee, D. Ryan, T. A. Dixon, P. A. J. Huber and S. M. Nasser. *Clinical and Experimental Allergy* (2008), 38: 260–275.

Nasal showers are a first-choice treatment for both acute and chronic rhinosinusitis, in the absence or presence of nasal polyposis.

**European position paper on rhinosinusitis and nasal polyps.** *Official journal of the European and International Societies.* 2012.

Xylitol has been shown to reduce nasal bacterial carriage, otitis media and cavities *in vivo*. Diluted in water, it is a well-tolerated agent for sinonasal irrigation, reducing more efficiently the symptoms of chronic rhinosinusitis compared to saline irrigation alone.

**\*Medical Therapies for Adult Chronic Sinusitis: A Systematic Review.** Rudmik, L. and Z. M. Soler. *JAMA* 314, no. 9 (2015): 926-39.

Systematic review analyzing randomized clinical trials, reviews and meta-analysis on therapies for managing adult rhinosinusitis. It concludes that evidence supports daily high-volume saline irrigation and topical corticosteroid therapy as a first-line therapy for chronic sinusitis.

**Saline irrigation for allergic rhinitis.** Head K, Snidvongs K, Glew S, Scadding G, Schilder AGM, Philpott C, Hopkins C. *Cochrane Database of Systematic Reviews* 2018, Issue 6.

Review of 14 studies including children and adults: Saline irrigation may reduce patient-reported disease severity compared with no saline irrigation at up to three months in both adults and children with allergic rhinitis, with no reported adverse effects.

**\*Update on Intranasal Medications in Rhinosinusitis.** Snidvongs, K. and S. Thanaviratananich. *Curr Allergy Asthma Rep* 17, no. 7 (2017): 47.

This review describes beneficial effects and adverse events of various intranasal medications in treating rhinosinusitis, including intranasal steroids and nasal irrigation. No serious adverse events have been found for nasal irrigation.

**\*\*Beneficial Effect of Nasal Saline Irrigation in Children with Allergic Rhinitis and Asthma: A Randomized Clinical Trial.** Jung, M., J. Y. Lee, G. R10.12932/AP-070918-0403yu, K. E. Lee, S. D. Hong, J. Choi, S. Kim, K. Ahn, H. J. Dhong, S. K. Chung, J. Kim and H. Y. Kim. *Asian Pac J Allergy Immunol*, (2019).

A randomized clinical trial showing that nasal saline irrigation is beneficial for the treatment of asthma and allergic rhinitis in children.

**Chronic Rhinosinusitis with Nasal Polyps.** Hopkins, B.M. *N Eng J Med* (2019), 381:55-63.

This article provides a treatment algorithm (including nasal irrigation) for adults with chronic rhinosinusitis and nasal polyps, based on current guidelines and best available evidence.

**\*\*Nasal Saline Irrigation with or without Systemic Antibiotics in Treatment of Children with Acute Rhinosinusitis.** Ragab, A., T. Farahat, G. Al-Hendawy, R. Samaka, S. Ragab and A. El-Ghobashy. *Int J Pediatr Otorhinolaryngol* 79, no. 12 (2015): 2178-86.

This is a prospective randomized, blind, placebo-controlled trial, including 62 children with uncomplicated acute rhinosinusitis. Authors concluded that nasal saline irrigation (NSI) can be used alone with the same clinical and bacteriological efficacy and with higher safety profile than amoxicillin + NSI after 14 days of treatment.

**\*The Use of Large Volume Low Pressure Nasal Saline with Fluticasone Propionate for the Treatment of Pediatric Acute Rhinosinusitis.** Tugrul, S., R. Dogan, S. B. Eren, A. Meric and O. Ozturan. *Int J Pediatr Otorhinolaryngol* 78, no. 8 (2014): 1393-9.

In this study, including ninety-one pediatric patients with acute rhinosinusitis, low pressure nasal saline plus fluticasone propionate is faster than antibiotherapy and nasal decongestant in improving clinical symptoms.

**\*\*Long-Term Outcome of Once Daily Nasal Irrigation for the Treatment of Pediatric Chronic Rhinosinusitis.** Pham, V., K. Sykes and J. Wei. *Laryngoscope* 124, no. 4 (2014): 1000-7.

Nasal irrigation is effective as a first-line treatment for pediatric chronic rhinosinusitis and subsequent nasal symptoms, and reduces the need for sinus surgery and tomography imaging.

**\*Isotonic Saline Nasal Irrigation Is an Effective Adjunctive Therapy to Intranasal Corticosteroid Spray in Allergic Rhinitis.** Nguyen, S. A., A. J. Psaltis and R. J. Schlosser. *Am J Rhinol Allergy* 28, no. 4 (2014): 308-11.

Large-volume, low-positive pressure nasal irrigation with isotonic saline is an effective adjunctive therapy to improve quality of life in patients with allergic rhinitis already on intranasal corticosteroid therapy.

**\*Effect of the Temperature of Nasal Lavages on Mucociliary Clearance: A Randomised Controlled Trial.** Sauvalle, M. and A. Alvo. *Eur Arch Otorhinolaryngol* 275, no. 9 (2018): 2403-2406.

Nasal lavages with saline solution improve mucociliary clearance as measured by saccharin test. Temperature is relevant, with 37° C nasal lavages providing the highest benefit.

**\*How does sinus surgery affect topical irrigation distribution?** Sandro H. de Paiva Leite and Richard G. Douglas. *Curr Opin Otolaryngol Head Neck Surg* 2018, 26(1):21-26

Postoperative lavage of the paranasal sinus is a recognized adjuvant in the treatment of chronic rhinosinusitis. It allows the association of topical medications that can be carried to the paranasal sinuses along with the saline, increasing the reach of these drugs. Among different options, it is preferable to use high-volume nasal irrigations through squeeze bottles.

**Saline Irrigations Following Sinus Surgery - a Controlled, Single Blinded, Randomized Trial.** Giotakis, A. I., E. M. Karow, M. O. Scheithauer, R. Weber and H. Riechelmann. *Rhinology* 54, no. 4 (2016): 302-310.

Nasal irrigation improves symptom score after endoscopic sinus surgery in patients with chronic rhinosinusitis with nasal polyps.

**\*Corticosteroid nasal irrigations are more effective than simple sprays in a randomized double-blinded placebo-controlled trial for chronic rhinosinusitis after sinus surgery.** Harvey RJ, Snidvongs K, Kalish LH, Oakley GM, Sacks R. *Int Forum Allergy Rhinol.* 2018;XX:1-10.

In chronic rhinosinusitis disease, the use of corticosteroid delivered by nasal irrigation is superior to simple nasal spray in postsurgical patients.

**Nasal saline irrigation in children: a study of compliance and tolerance.** Jeffe JS. *Int J Pediatr Otorhinolaryngol* (2012), 409:13.

93% of the children included in the study used nasal saline irrigation and reported symptomatic improvement. Only 28% of parents thought it would be a tolerated treatment by the child. As conclusion, the biggest obstacle to nasal irrigation in children is parents reluctance, showing that regardless of age, the children were judged by the parents.

**Nasal saline for chronic sinonasal symptoms: a randomized controlled trial.** Pynnonen MA, Mukerji SS, Kim HM, Adams ME, Terrell JE. *Arch Otolaryngol Head Neck Surg* (2007). 133:1115-20.

Nasal irrigation performed with large volumes of irrigation fluid is more effective than pressurized sprays for the treatment of sinonasal symptoms.

**Safety and efficacy of once-daily nasal irrigation for the treatment of pediatric chronic rhinosinusitis.** Wei JL. *Laryngoscope* (2011), 1989:2000.

Daily nasal irrigation for 6 weeks is safe and effective in the treatment of chronic pediatric rhinosinusitis. No differences were found between the use of saline solution alone or combined with gentamicin, and quality of life improved significantly after 3 weeks in both groups. The high tolerance, compliance and effectiveness of irrigation support its use as a first-line treatment for pediatric chronic rhinosinusitis before considering surgical intervention.

**Topical Drug Delivery for Chronic Rhinosinusitis.** Liang J. and Lane A.P. *Curr Otoehinolaryngol Rep.* (2013) 1(1):51-60.

Devices and pharmaceutical agents to apply topical medical therapy to the sinuses are reviewed. Drug addition to large-volume, low-pressure nasal irrigation can be an effective option for the management of chronic rhinosinusitis.

**A comparative Study of Three Methods of Nasal Irrigation.** Wormald PJ, Cain T, Oates L, Hawke L, Wong I. *Laryngoscope* (2004) 114:2224.

Positive pressure nasal irrigation (SinuSalt) is more effective than nasal sprays or nebulizations to distribute the irrigation solution in the maxillary sinuses and in the frontal recess. This should be the method of choice for the irrigation of these areas.

**Xylitol Nasal Irrigation in the Treatment of Chronic Rhinosinusitis.** Lin, L., X. Tang, J. Wei, F. Dai and G. Sun. *Am J Otolaryngol* 38, no. 4 (2017): 383-389.

Xylitol nasal irrigation results in greater improvement of symptoms in chronic rhinosinusitis and greater enhancement of nasal nitric oxide in maxillary sinus, as compared to saline nasal irrigation alone.

**Xylitol nasal irrigation in the management of chronic rhinosinusitis: a pilot study.** Weissman JD. *Laryngoscope* (2011), 2468:72.

The irrigation with xylitol generates a great improvement of chronic rhinosinusitis symptoms in comparison with saline irrigation alone.

## **NASAL IRRIGATION**

### **1. Sinusitis/Rhinosinusitis**

**Clinical Guidelines on Chronic Rhinosinusitis in Children.** Chandy, Z., E. Ference and J. T. Lee. *Curr Allergy Asthma Rep* 19, no. 2 (2019): 14.

This review provides an overview of the current guidelines and recent literature regarding the diagnosis, microbiology, and treatment options of chronic rhinosinusitis in the pediatric population. Nasal saline irrigation is recommended as a first-line treatment option, well supported in current literature.

**Chronic Rhinosinusitis with Nasal Polyps.** Hopkins, B.M. *N Eng J Med* (2019), 381:55-63.

This article provides a treatment algorithm (including nasal irrigation) for adults with chronic rhinosinusitis and nasal polyps, based on current guidelines and best available evidence.

**Nasal Saline Irrigation in Pediatric Rhinosinusitis: A Systematic Review.** Gallant, J. N., J. I. Basem, J. H. Turner, C. N. Shannon and F. W. Virgin. *Int J Pediatr Otorhinolaryngol* 108, (2018): 155-162.

Nasal saline irrigation may provide benefit for acute rhinosinusitis in children. Additional studies are needed to quantify the efficacy of this therapy.

**\*Update on Intranasal Medications in Rhinosinusitis.** Snidvongs, K. and S. Thanaviratananich. *Curr Allergy Asthma Rep* 17, no. 7 (2017): 47.

This review describes beneficial effects and adverse events of various intranasal medications in treating rhinosinusitis, including intranasal steroids and nasal irrigation. No serious adverse events have been found for nasal irrigation.

**Pediatric Rhinosinusitis.** Badr, D. T., J. M. Gaffin and W. Phipatanakul. *Curr Treat Options Allergy* 3, no. 3 (2016): 268-281.

The standard treatment of pediatric acute bacterial rhinosinusitis is nasal irrigation and antibiotic use.

**Current Concepts in Adult Acute Rhinosinusitis.** Aring, A. M. and M. M. Chan. *Am Fam Physician* 94, no. 2 (2016): 97-105.

Key recommendations for practice in acute rhinosinusitis, including nasal saline irrigation for symptomatic treatment.

**\*Medical Therapies for Adult Chronic Sinusitis: A Systematic Review.** Rudmik, L. and Z. M. Soler. *JAMA* 314, no. 9 (2015): 926-39.

Systematic review analyzing randomized clinical trials, reviews and meta-analysis on therapies for managing adult rhinosinusitis. It concludes that evidence supports daily high-volume saline irrigation and topical corticosteroid therapy as a first-line therapy for chronic sinusitis.

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Updated guideline that provides evidence-based recommendations to manage adult rhinosinusitis. Among others, the update group made *recommendations*, including that clinicians should suggest saline nasal irrigation, topical intranasal corticosteroids, or both for symptom relief of chronic rhinosinusitis.

**Effects of Nasal Saline Lavage on Pediatric Sinusitis Symptoms and Disease-Specific Quality of Life: A Case Series of 10 Patients.** Lin, S. Y., K. M. Baugher, D. J. Brown and S. L. Ishman. *Ear Nose Throat J* 94, no. 2 (2015): E13-8.

The results of this pilot study suggest that nasal saline lavage may significantly alleviate chronic sinonasal symptoms and improve disease-specific quality of life in children with symptoms of chronic rhinosinusitis.

**\*\*Nasal Saline Irrigation with or without Systemic Antibiotics in Treatment of Children with Acute Rhinosinusitis.** Ragab, A., T. Farahat, G. Al-Hendawy, R. Samaka, S. Ragab and A. El-Ghobashy. *Int J Pediatr Otorhinolaryngol* 79, no. 12 (2015): 2178-86.

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**Efficacy of Nasal Irrigation in the Treatment of Acute Sinusitis in Atopic Children.** Wang, Y. H., M. S. Ku, H. L. Sun and K. H. Lue. *J Microbiol Immunol Infect* 47, no. 1 (2014): 63-9.

Nasal irrigation is an effective adjunctive treatment for acute sinusitis in atopic children.

**A Comparison of the Efficacy of Amoxicillin and Nasal Irrigation in Treatment of Acute Sinusitis in Children.** Khoshdel, A., G. R. Panahande, M. K. Noorbakhsh, M. R. Malek Ahmadi, M. Lotfizadeh and N. Parvin. *Korean J Pediatr* 57, no. 11 (2014): 479-83.

This is a randomized, double-blind, controlled study including 80 children with acute sinusitis. High-dose amoxicillin with saline nasal irrigation relieved acute sinusitis symptoms faster but confers only a small global therapeutic benefit over nasal irrigation alone.

**\*\*Long-Term Outcome of Once Daily Nasal Irrigation for the Treatment of Pediatric Chronic Rhinosinusitis.** Pham, V., K. Sykes and J. Wei. *Laryngoscope* 124, no. 4 (2014): 1000-7.

Nasal irrigation is effective as a first-line treatment for pediatric chronic rhinosinusitis and subsequent nasal symptoms, and reduces the need for sinus surgery and tomography imaging.

**Topical Therapies in the Management of Chronic Rhinosinusitis: An Evidence-Based Review with Recommendations.** Rudmik, L., M. Hoy, R. J. Schlosser, R. J. Harvey, K. C. Welch, V. Lund and T. L. Smith. *Int Forum Allergy Rhinol* 3, no. 4 (2013): 281-98.

This evidence-based review recommends sinonasal saline irrigation and standard topical nasal steroid therapy in the treatment of chronic rhinosinusitis, but is against the use of topical antifungal or antibiotic therapy using nebulized and spray techniques.

**Nasal Saline Irrigations for the Symptoms of Acute and Chronic Rhinosinusitis.** Nils Achilles. *Current Allergy Asthma Reports*. (2013) 229:235.

Nasal saline irrigation is one of the mainstays of an efficient treatment for chronic rhinosinusitis.

**Efficacy of nasal irrigations and nebulizations for nasal symptom relief.** Dunn JD. *Curr Opin Otolaryngol Head Neck Surg* (2013): 248:51.

Saline irrigation may improve sinonasal disease symptoms, together with outcomes in certain contexts. Moreover, the use of xylitol in chronic rhinosinusitis provides promising results.

**Nasal irrigation with or without drugs: the evidence.** Nithin D. Adappa. *Current Opinion* (2012) 1068:9508.

Saline irrigation is beneficial for the treatment of chronic rhinosinusitis symptoms.

**Efficacy of nasal irrigation in the treatment of acute sinusitis in atopic children.** Yun-Hu Wang. *Journal of microbiology, Immunology and Infection* (2012): 1-7.

Nasal saline irrigation improves the quality of life in pediatric rhinoconjunctivitis and is effective as a coadjuvant treatment in acute sinusitis in atopic children.

**Chronic rhinosinusitis: Epidemiology and medical Management.** Daniel L. Hamilos. *Clinical reviews in allergy and immunology* (2011), 693:707.

Nasal saline irrigation is an effective adjuvant treatment for chronic rhinosinusitis.

**Safety and efficacy of once-daily nasal irrigation for the treatment of pediatric chronic rhinosinusitis.** Wei JL. *Laryngoscope* (2011), 1989:2000.

Daily nasal irrigation for 6 weeks is safe and effective in the treatment of chronic pediatric rhinosinusitis. No differences were found between the use of saline solution alone or combined with gentamicin, and quality of life improved significantly after 3 weeks in both groups. The high tolerance, compliance and effectiveness of irrigation support its use as a first-line treatment for pediatric chronic rhinosinusitis before considering surgical intervention.

**EPOS Primary Care Guidelines: European Position Paper on the Primary Care Diagnosis and Management of Rhinosinusitis and Nasal Polyps 2007 - a summary.** Thomas M, Yawn BP, Price D, Lund V, Mullol J, Fokkens W; European Position Paper on Rhinosinusitis and Nasal Polyps Group. *Prim Care Respir* (2008) J.17:79-89.



Nasal irrigation is a first-line treatment for chronic rhinosinusitis, together or not with nasal polyposis.

**BSACI guidelines for the management of rhinosinusitis and nasal polyposis** G. K. Scadding, S. R. Durham, R. Mirakian, N. S. Jones, A. B. Drake-Lee, D. Ryan, T. A. Dixon, P. A. J. Huber and S. M. Nasser. *Clinical and Experimental Allergy* (2008), 38 : 260–275.

Nasal showers are a first-choice treatment for both acute and chronic rhinosinusitis, in the absence or presence of nasal polyposis.

**Nasal irrigation for chronic sinus symptoms in patients with allergic rhinitis, asthma, and nasal polyposis: a hypothesis generating study.** Rabago D, Guerard E, Bukstein D. *WJM* (2008). 107(2):69-75.

Daily nasal irrigation improves the symptoms and quality of life of patients with chronic rhinosinusitis.

**Nasal Saline Irrigations for the Symptoms of Chronic Rhinosinusitis.** Harvey R, Hannan S, Badia L, Scadding G. *Cochrane Database Syst Rev* (2007). 18:CD006394.

Systematic review of all clinical studies published in the literature (1950-2006) according to the Cochrane method. It is concluded that nasal irrigation is well-tolerated and beneficial. Its application in the treatment of chronic rhinosinusitis is suggested.

**Pediatric sinusitis.** Tan R, Spector S. *Curr Allergy Asthma Rep* (2007). 7:421-6.

Nasal irrigation is an adjuvant treatment for sinusitis in children.

**Qualitative Aspects of Nasal Irrigation Use by Patients with Chronic Sinus Disease in a Multimethod Study.** Rabago D, Barrett B, Marchand L, Maberry R, Mundt M. *Ann Fam Med* (2006). 4:295.

Nasal irrigation is a safe, effective and economical treatment for the chronic treatment of sinonasal diseases.

**Nasal irrigation in case of rhinosinusitis.** Michel O. *Laryngorhinootologie* (2006), 85:448.

Nasal irrigation is safe and effective. It may decrease the use of nasal antibiotics and decongestants, being useful for the treatment of rhinosinusitis.

**Evidence-based Recommendations for Antimicrobial Nasal Washes in Chronic Rhinosinusitis.** Elliott KA, Stringer SP. *Am J Rhinol* (2006). 20:1.

Nasal irrigation together with antimicrobial agents is a potential effective treatment for the increasing group of patients who remain symptomatic after appropriate medical and surgical treatment.

**The Efficacy of Hypertonic Saline Nasal Irrigation for Chronic Sinonasal Symptoms.** Rabago D, Pasic T, Zgierska A, Mundt M, Barrett B, Maberry R. *Otolaryngol Head Neck Surg* (2005). 133:3.

This is a study in 54 patients with chronic sinusitis where it is demonstrated that both quality of life and symptoms improve significantly upon regular nasal irrigation.

**Chronic Sinusitis in Children.** Steele RW. *Clin Pediatr* (2005). 44:465.

Review on the treatment of chronic sinusitis in pediatrics. Nasal irrigation is an adjuvant treatment that is especially effective.

**Management for Optimal Outcomes.** Aukema AA, Fokkens WJ. *Treat Respir Med* (2004).3: 97.

Nasal irrigation with a saline solution along with nasal steroids are the basis of the treatment of chronic sinusitis.

**Nasal Irrigations: Good or Bad?** Brown CL, Graham SM. *Curr Opin Otolaryngol Head Neck Surg* (2004). 12:9, 2004

Nasal irrigation with saline solutions cannot be considered as a mere adjunctive treatment of rhinosinusitis any longer. Despite being effective and safe, it is underutilized.

**When Sinus Trouble Won't Stay Away: for people with chronic sinusitis, nasal irrigation and surgery offer avenues for fewer relapses and better breathing.** Metson R. *Health News* (2004). 10:12.

Saline irrigation improves breathing and lengthens the time between relapses.

**Nasal Irrigation as Adjunctive Care for Acute Sinusitis.** Rabago D, Barrett B, Zgierska A. *J Fam Pract* (2004). 53:137.

Saline irrigation is a first-line treatment for acute sinusitis.

**Acute Bacterial Rhinosinusitis in Adults: part II. Treatment** Scheid DC, Hamm RM. *Am Fam Physician* (2004). 70:1697.

Different treatments of acute bacterial rhinosinusitis are reviewed. Regarding nasal irrigation, authors conclude that nasal irrigation is beneficial without causing adverse effects.

**Clinical and Pathogenetic Characteristics of Pregnancy Rhinitis.** Ellegard EK. *Clin Rev Allergy Immunol* (2004). 26:149.

Saline irrigation is recommended for the treatment of pregnancy rhinitis in place of nasal decongestants, that should be avoided.

**Concomitant Chronic Sinusitis Treatment in Children with Mild Asthma: the effect on bronchial hyperresponsiveness.** Tsao CH, Chen LC, Yeh KW, Huang JL. *Chest* (2003). 123:757.

Postnasal drip, nasal congestion and nighttime coughing in children with chronic sinusitis associated with mild asthma are improved just with saline irrigation.

**Saline Nasal Irrigation: Its role as an adjunct treatment.** Papsin B, McTavish A. *Can Fam Physician* (2003). 49:168.

Nasal irrigation is a simple and inexpensive treatment that improves the symptoms of a variety of sinonasal diseases, reducing the use of resources and minimizing resistance to antibiotics.

**Efficacy of Daily Hypertonic Saline Nasal Irrigation Among Patients with Sinusitis: a randomized controlled trial.** Rabago D, Zgierska A, Mundt M, Barrett B, Bobula J, Maberry R. *J Fam Pract* (2002). 51:1049.

Daily saline irrigation improves the quality of life of patients with sinusitis, decreasing symptoms and medication uptake.

**Nasal Irrigation for the Alleviation of Sinonasal Symptoms.** Heatley DG, McConnell KE, Kille TL, Levenson GE. *Otolaryngol Head Neck Surg* (2001). 125:44.

Nasal irrigation improves the symptoms of sinusitis in 70% of the patients studied, reducing the need for medication consumption in 50% of them.

**Management of Sinusitis: current clinical strategies.** Kaliner M, Kennedy DW, en: *Sinusitis Disease Management Guide* (2000). PDR 2000.

The use of saline irrigation in chronic sinusitis treatment protocols is emphasized.

**Clinical Study and Literature Review of Nasal Irrigation.** Tomooka LT, Murphy C, Davidson TM. *Laryngoscope* (2000) 110:1189.

Nasal irrigation is very effective in improving the symptoms and health of sinonasal disease patients.

**Effect of Irrigation of the Nose with Isotonic Salt Solution on Adult Patients with Chronic Paranasal Sinus Disease.** Bachmann G, Hommel G, Michel O. *European Archives of Otorhinolaryngology* (2000). 257:537.

Nasal irrigation with isotonic saline solution is effective for the treatment of chronic sinusitis.

**Nasal Douching as a Valuable Adjunct in the Management of Chronic Rhinosinusitis.** Taccariello M, Parikh A, Darby Y, Scadding G. *Rhinology* (1999) 37:29.

Nasal irrigation improves the endoscopic image of the nasal mucosa and the quality of life of patients with chronic rhinosinusitis, while remaining unchanged in the control group (without irrigation).

**Treatment of Sinusitis in the Next Millennium.** Kaliner M. *Allergy and Asthma Proceedings* (1998), 19:181.

Saline irrigation is a non-pharmacological treatment that is recommended for the treatment of sinusitis.

**Sinusitis: Acute, Chronic and Manageable.** Rachelevsky GS, Slavin RG. *Patient Care* (1997) 131:4.

Saline irrigation is a particularly effective strategy for sinusitis treatment. If done regularly, it is so effective in eliminating nasal obstruction that some patients with chronic or persistent sinusitis do not need any pharmacological treatment.

**Efficacy of Sinus Irrigation Versus Sinus Irrigation Followed by Functional Endoscopic Sinus Surgery.** Hartog B, van Benthem PP, Prins LC, Hordijk GJ *Annals of Otolaryngology, Rhinology and Laryngology* (1997) 106:759.

Sinonasal irrigation alone prevented the need for surgery in 58% of patients with chronic sinusitis for one year.

**Management of Sinusitis in Adult Cystic Fibrosis.** Marks SC, Kissner DG. *American Journal of Rhinology* (1997) 11:11.

Daily cleaning of the nasal and sinus pits by saline irrigation is important for the prevention of infections in patients with cystic fibrosis.

**Sinusitis: Bench to Bedside.** Kaliner MA et al. Study group of sinusitis. *Otolaryngology* (1997) 116:6.

Saline irrigation is recommended as an effective treatment for sinusitis, supplementary to other therapeutic modalities.

**Chronic Sinusitis. A Medical or Surgical Disease?** Parson DS. En: *Pediatric Sinusitis. Otolaryngologic Clinics of North America* (1996) 29:1.

Saline irrigation on a regular basis is one of the most effective methods to reduce mucosal edema. If nasal steroids are used, they are more effective if they are administered on the mucosa that has been cleansed and decongested previously with saline irrigation.

**Medical Management of Rhinitis.** Fadal R. *Otolaryngology, Gerald M English* (1996) Ed. Vol 2:Ch 13.

Saline irrigation is very effective for the management of allergic and infectious rhinitis. The main benefits of saline irrigation include: 1. Increase of mucociliary flow 2. Dilution of thick secretions 3. Relieve of irritated mucosa 4. Elimination of crusts and foreign bodies 5. Facilitated healing of mucous membranes 6. Reduction of the need to blow 7. Improvement of smell.

**Atrophic Rhinitis.** De Souza FM. *Otolaryngology, Gerald M English* (1996) Ed., Ch14, 1996

The Grossan nasal irrigator coupled to the WaterPik has increased the efficiency of nasal saline showers.

**Sinus Survival.** Ivker R. *Putman Publication*. 1995

Without need for drug consumption, saline irrigation is able to eliminate pus, allowing a disease recovery in a natural and non-aggressive way.

**Sinusitis: complications and sequelae. An Otolaryngologist's Perspective.** Fairbanks DNF. *Pediatric Infectious Diseases* (1995), 74:875.

Part of the radiographic material placed in the nostrils before bedtime could be detected in the tracheobronchial tree the morning after. This might explain why sinus secretions cause infections in the lower airways, including bronchitis and bronchospasm. Hence, the great value of saline irrigation is to eliminate infectious secretions in the upper respiratory tract, thus preventing its spread.

**Management of Sinusitis in Cystic Fibrosis.** Moss RB, King W. *Archives of Otolaryngology Head Neck Surgery* (1995), 21:566.

Emphasis is placed on the use of saline irrigation for regular treatment at home. Authors recommend the addition of antibiotics for the irrigation of the sinuses.

**Management of Chronic Sinusitis in Cystic Fibrosis.** Davidson T. *Laryngoscope* (1995) 105:354.

Cystic fibrosis is frequently associated with sinusitis because of poor functioning of the mucociliary system. Pulsed saline irrigation is recommended to clean the sinuses, improving mucociliary function and decreasing the viscosity of secretions.

**Prospects for Ancillary Treatment of Sinusitis in the 1990s.** Zeiger RS. *Journal of Allergy and Clinical Immunology* (1994), 90:478.

Saline irrigation improves mucociliary clearance and decreases mucus viscosity.

**Therapeutic Agents in the Medical Management of Sinusitis.** Mabry RL. En: *Inflammatory Diseases of the Sinuses. Otolaryngologic Clinics of North America* (1993) 26:561.

In addition to the administration of mucolytics, it is necessary to clean the thick mucus and sinus secretions by saline irrigation. This procedure is not only beneficial for patients with annoying thick mucus, but also it is especially useful for postoperative cleaning after intranasal sinus surgery.

**Pediatric Sinusitis.** Manning SC. *Otolaryngologic Clinics of North America* (1993) 26:623.

It is necessary to emphasize to parents the need to perform nasal irrigation once or twice a day as one of the main strategies for the prevention of sinusitis, in the same way that teeth brushing prevents cavities.

**Rhinitis and Nasal Obstruction.** Lucente FE. En: Nasal Obstruction. *Otolaryngologic Clinics of North America* (1989) 22:307.

Atrophic rhinitis benefits from nasal irrigation.

**Atrophic Rhinitis.** Goodman. *Otolaryngology, Gerald M English* (1984) Ed. Vol 2, Ch. 14.

Atrophic rhinitis varies in severity and is difficult to cure. Saline irrigation is recommended as a very useful treatment for it.

**Chronic Rhinitis, a Practical Approach to Diagnosis and Treatment.** Zeigler R, Shatz M. *Immunology and Allergy Practice* (1982) 4:2.

The use of saline irrigation to eliminate harmful particles and restore normal ciliary flow is included for the correct management of nasal allergic diseases.

## 2. Allergic Rhinitis

**\*\*Beneficial Effect of Nasal Saline Irrigation in Children with Allergic Rhinitis and Asthma: A Randomized Clinical Trial.** Jung, M., J. Y. Lee, G. R10.12932/AP-070918-0403yu, K. E. Lee, S. D. Hong, J. Choi, S. Kim, K. Ahn, H. J. Dhong, S. K. Chung, J. Kim and H. Y. Kim. *Asian Pac J Allergy Immunol*, (2019).

A randomized clinical trial showing that nasal saline irrigation is beneficial for the treatment of asthma and allergic rhinitis in children.

**Saline irrigation for allergic rhinitis.** Head K, Snidvongs K, Glew S, Scadding G, Schilder AGM, Philpott C, Hopkins C. *Cochrane Database of Systematic Reviews* 2018, Issue 6.

Review of 14 studies including children and adults: Saline irrigation may reduce patient-reported disease severity compared with no saline irrigation at up to three months in both adults and children with allergic rhinitis, with no reported adverse effects.

**The Acceptability and Tolerability of Nasal Douching in Children with Allergic Rhinitis: A Systematic Review.** Gutierrez-Cardona, N., P. Sands, G. Roberts, J. S. Lucas, W. Walker, R. Salib, A. Burgess and H. Ismail-Koch. *Int J Pediatr Otorhinolaryngol* 98, (2017): 126-135.

Nasal saline douching appears to be effective, being accepted and tolerated and has a significant positive impact on the quality of life in children with allergic rhinitis.

**Treatment of Allergic Rhinitis.** Sur, D. K. and M. L. Plesa. *Am Fam Physician* 92, no. 11 (2015): 985-92.

Among recommended treatments, non-pharmacological therapies such as nasal irrigation are included.

**The Effectiveness of Nasal Saline Irrigation (Seawater) in Treatment of Allergic Rhinitis in Children.** Chen, J. R., L. Jin and X. Y. Li. *Int J Pediatr Otorhinolaryngol* 78, no. 7 (2014): 1115-8.

Nasal saline irrigation improves the effectiveness of intranasal corticosteroids alone in children with allergic rhinitis and is proposed as an adjunctive therapy.

**\*Isotonic Saline Nasal Irrigation Is an Effective Adjunctive Therapy to Intranasal Corticosteroid Spray in Allergic Rhinitis.** Nguyen, S. A., A. J. Psaltis and R. J. Schlosser. *Am J Rhinol Allergy* 28, no. 4 (2014): 308-11.

Large-volume, low-positive pressure nasal irrigation with isotonic saline is an effective adjunctive therapy to improve quality of life in patients with allergic rhinitis already on intranasal corticosteroid therapy.

**Tap water nasal irrigation in adults with seasonal allergic rhinitis: a randomized double-blind study.** Min Xiong. *Eur Arch Otorhinolaryngol* (2013), 2741:4.

Nasal irrigation, apart from being convenient and inexpensive, is effective to control the symptoms of seasonal allergic rhinitis in the adult patient.

**Efficacy of nasal irrigation in the treatment of acute sinusitis in atopic children.** Yun-Hu Wang. *Journal of microbiology, Immunology and Infection* (2012), 1-7.

Nasal saline irrigation improves the quality of life in pediatric rhinoconjunctivitis and is effective as a co-adjutant treatment in acute sinusitis in atopic children.



**Nasal irrigation as an adjunctive treatment in allergic rhinitis: a systematic review and meta-analysis.** Hermelingmeier KE. *Am J Rhinol Allergy* (2012), 119:25.

Isotonic saline nasal irrigation may be recommended as a complementary therapy in allergic rhinitis. It is well-tolerated, inexpensive and easy to use.

**Hypertonic saline is more effective than normal saline in seasonal allergic rhinitis in children.** Marchisio P. *Int J Immunopathol Pharmacol* (2012), 721:30.

Saline irrigation is effective, cheap, safe, well-tolerated and easily accepted by children with grass pollen-mediated allergic rhinitis. Thus, it could be included among therapies recommended for this pathology.

**Efficacy of buffered hypertonic saline nasal irrigation in children with symptomatic allergic rhinitis: a randomized double-blind study.** Satdhabudha A. *Int J Pediatr Otorhinolaryngol* (2012), 583:8.

Nasal irrigation with hypertonic saline results in improved symptom score, nasal saccharin transit time and quality of life, compared to normal saline, in children with symptomatic allergic rhinitis.

**Nasal saline irrigation facilitates control of allergic rhinitis by topical steroid in children.** Li H, Sha Q, Zuo K, Jiang H, Cheng L, Shi J, Xu G. *ORL J Otorhinolaryngol Relat Spec* (2009).71:50-5.

Nasal irrigation is a good treatment for allergic rhinitis. It allows to control rhinitis with reduced administration of topical corticosteroids.

**Nasal Rinsing with Hypertonic Solution: an Adjunctive Treatment for Pediatric Seasonal Allergic Rhinoconjunctivitis.** Garavello W, Di Berardino F, Romagnoli M, Sambataro G, Gaini RM. *Int Arch Allergy Immunol* 82(2005). 137:310.

Nasal irrigation during the pollen season improves symptoms and reduces the use of antihistamines in children with allergic rhinoconjunctivitis.

**Is Hypertonic Saline Better than Normal Saline for Allergic Rhinitis in Children?** Degirmencioglu H, Karadag A, Avci Z, Kurtaran H, Catal F. *Pediatr Allergy Immunol* (2004). 15:190.

Saline irrigation with isotonic or hypertonic solutions improves symptoms during the pollen season.

**Nasal Saline for Allergic Rhinitis: an Alternative Treatment Method.** Yilmaz T, Kurtaran H, Karadag A, Uras N. *Acta Otolaryngol* (2004). 124:1240.

Saline irrigation is effective for the treatment of allergic rhinitis.

**Hypersaline Nasal Irrigation in Children with Symptomatic Seasonal Allergic Rhinitis: a Randomized Study.** Garavello W, Romagnoli M, Sordo L, Gaini RM, Di Bernardino C, Angrisano A. *Pediatr Allergy Immunol* (2003). 14:140.

Saline irrigation with hypertonic solutions during the pollen season reduces symptoms and medication consumption.

**Inhibition of the Seasonal IgE Increase to *Dactylis glomerata* by Daily Sodium Chloride Nasal-sinus Irrigation During the Grass Pollen Season.** Subiza JL, Subiza J, Barjau MC, Rodríguez R, Gavilán MJ. *Journal of Allergy and Clinical Immunology* (1999), 104:711.

Saline irrigation of the nose and paranasal sinuses during the flowering season inhibits the IgE-mediated response to grass pollens.

**Pathophysiology and Treatment of Allergic Sinusitis.** Kaliner, M.A. En: Current Review of Allergic Diseases, Michael A. Kaliner (ed.), *Current Medicine* (1998), p.125.

Nasal irrigation is important in the treatment of allergic rhinosinusitis.

**Nasal Hyperthermia and Simple Irrigation for Perennial Rhinitis. Changes in Inflammatory Mediators.** Georgitis JW. *Chest* (1994), 106:1487.

Saline irrigation significantly reduces inflammatory mediators present in patients with perennial allergic rhinitis. This decrease is maintained up to six hours after irrigation.

**Rinitis Alérgica y no Alérgica.** Meltzer EO et al. En: Alergia: principios y práctica. Middleton E, Reed Ch, Ellis EF, Adkinson NF, Yunginger JW, eds., vol 2, Salvat (1992), 1181.

All forms of allergic rhinitis benefit from saline irrigation.

### 3. Mucociliary clearance

**\*Effect of the Temperature of Nasal Lavages on Mucociliary Clearance: A Randomised Controlled Trial.** Sauvalle, M. and A. Alvo. *Eur Arch Otorhinolaryngol* 275, no. 9 (2018): 2403-2406.

Nasal lavages with saline solution improve mucociliary clearance as measured by saccharin test. Temperature is relevant, with 37° C nasal lavages providing the highest benefit.

**The impact of hypertonic saline inhalation on mucociliary clearance and nasal nitric oxide.** A. Bencova. *Journal of physiology and pharmacology* (2012), 309:313.

Increased mucociliary clearance in response to hyperosmolar saline may help eliminate accumulated secretions in the airways and prevent respiratory tract infections.

**Impact of isotonic and hypertonic saline solutions on mucociliary activity in various nasal pathologies: clinical study.** Ural A, Oktemer TK, Kizil Y, Ileri F, Uslu S. *Laryngol Otol* (2008). 28:1-5.

Sinonasal irrigation with isotonic solutions improves mucociliary function in allergic rhinitis and acute sinusitis. Otherwise, hypertonic solutions improve this function in chronic sinusitis.

**Ringer-Lactate Solution Versus Isotonic Saline Solution on Mucociliary Function after Nasal Septal Surgery.** Unal M, Gorur K, Ozcan C. *J Laryngol Otol* (2001). 115:796.

Irrigation with Ringer's solution (SinuSalt) results in a faster recovery of mucociliary function in operated patients than irrigation with physiological saline.

**Mucociliary Clearance and Buffered Hypertonic Saline Solution.** Talbot A, et al. *Laryngoscope* (1997) 107:500.

The importance of saline irrigation to recover mucociliary clearance in patients with acute or chronic sinusitis is emphasized.

**Enhancing the Mucociliary System.** Grossan M. (1995), 8:12.

Cough, wheezing and other respiratory symptoms can be significantly improved by performing pulsatile saline irrigation. Thanks to the irrigation, the purulent secretions of the sinuses can be quickly eliminated, thus preventing infection reaching to the lungs and improving the ciliary function.

**Office Measurement of Nasal Mucociliary Clearance.** Grossan M. *Otolaryngology* (1994), Gerald M English Ed. Vol 2, Ch 7.

The saccharin test allows an objective measurement of mucociliary function, one of the most important parts in the defense of the respiratory system. Thanks to this test, many dilemmas have been solved. Saccharin test reflects both nasal and thoracic aspects, issues that are improved by saline irrigation.

**Effect of Amiloride and Saline on Nasal Mucociliary Clearance and Potential Difference in Cystic Fibrosis and Normal Subjects.** Middleton PG, Geddes DM, Alton EW. *Thorax* (1993). 48:812.

Nasal irrigation improves mucociliary clearance, both in normal individuals and subjects affected by cystic fibrosis.

**Mucociliary Flow in Otolaryngology Practice.** Grossan M. *Insights in Otolaryngology* (1993), 8:2.

Many harmful substances such as smog, pollution, chlorine, chromium, etc. can block mucociliary clearance. In turn, the deterioration of the physiological ciliary activity can delay the recovery from sinus diseases. Nasal irrigation with saline solution is an important aid to achieve a more quickly recovery of the normal ciliary activity

**Ciliary Beating Frequency in Chronic Sinusitis.** Nuutinen J. *Archives of Otolaryngology Head Neck Surgery* (1993), 119:645.

Once thick secretions and bacteria have been removed, the ciliary function can be recovered.

**A Device to Aid Nasal Mucociliary Flow.** Grossan M. *A.N.L.* (1976) 3:65.

An increasing number of environmental factors produce ciliostasis, decreasing or blocking the function of the nasal cilia. Nasal irrigation restores mucociliary clearance in most cases as reflected by the saccharin test.

**The Saccharin Test of Nasal Mucociliary Function.** Grossan M. *Eye, Ear, Nose and Throat Monthly* (1975), 54:415.

It is an objective test to measure mucociliary clearance. It is useful to assess the ciliary function, before and after the treatment with nasal irrigation, in order to quantify the degree of improvement.

## 4. Nasal surgery

**The effects of nasal irrigation with various solutions after endoscopic sinus surgery: systematic review and meta-analysis.** Chen XZ, Feng SY, Chang LH, Lai XP, Chen XH, Li X, Zhang GH. *J Laryngol Otol* 2018;132:673–679.

Based on the current limited evidence, nasal irrigation is an effective therapy for chronic rhinosinusitis patients after functional endoscopic sinus surgery. However, when comparing various solutions with normal saline, no significant difference was found in symptom or endoscopic scores.

**\*How does sinus surgery affect topical irrigation distribution?** Sandro H. de Paiva Leite and Richard G. Douglas. *Curr Opin Otolaryngol Head Neck Surg* 2018, 26(1):21-26

Postoperative lavage of the paranasal sinus is a recognized adjuvant in the treatment of chronic rhinosinusitis. It allows the association of topical medications that can be carried to the paranasal sinuses along with the saline, increasing the reach of these drugs. Among different options, it is preferable to use high-volume nasal irrigations through squeeze bottles.

**Saline Irrigations Following Sinus Surgery - a Controlled, Single Blinded, Randomized Trial.** Giotakis, A. I., E. M. Karow, M. O. Scheithauer, R. Weber and H. Riechelmann. *Rhinology* 54, no. 4 (2016): 302-310.

Nasal irrigation improves symptom score after endoscopic sinus surgery in patients with chronic rhinosinusitis with nasal polyps.

**Single-blind randomized controlled trial of surfactant vs hypertonic saline irrigation following endoscopic endonasal surgery.** Farag AA. *Int Forum Allergy Rhinol* (2013), 276:80.

There are no significant differences in subjective symptoms related to sinonasal disease between the use of surfactant and hypertonic saline irrigation. However, there were more patients who reported side effects with surfactant (20% withdrawal), in comparison with none of those who used the saline irrigation.

**A prospective randomized single-blinded clinical trial comparing the efficacy and tolerability of the nasal douching products Sterimar™ and Sinus Rinse™ following functional endoscopic sinus surgery.** Salib RJ. *Clin Otolaryngol* (2013), 297:305.

Low pressure, large volume saline irrigation is recommended as an effective, easy to use and well-tolerated strategy for sinonasal endoscopic cleaning in the immediate postoperative period after nasaosinusal endoscopic surgery.

**Role of Medical Therapy in the Management of Nasal Polyps.** Isma Alobid. *Curr Allergy Asthma Rep* (2012), 144:153.

Saline irrigation reduces nasal secretions and improves edema during the healing phase after endoscopic surgery, displaying an anti-inflammatory role. There is a high level of evidence and it is recommended as a treatment in chronic rhinosinusitis.

**The impact of intraoperative saline irrigations on bacterial load within the maxillary sinus.** Seiberling KA. *Int Forum Allergy Rhinol* (2011), 351:5.

Intraoperative saline irrigations are able to significantly reduce the amount of potentially pathogenic bacteria within the diseased sinus mucosa.

**A preliminary randomised controlled trial evaluating the efficacy of saline douching following endoscopic sinus surgery.** Freeman SR, Sivayoham ES, Jepson K, de Carpentier J. *Clin Otolaryngol* (2008). 33:462-5.

Nasal irrigation reduces nasal discharge and can improve edema during the healing phase after endoscopic sinus surgery, likely mediated by an anti-inflammatory effect. There are no long-term adverse effects.

**Effects of endoscopic sinus surgery and delivery device on cadaver sinus irrigation.** Harvey RJ, Goddard JC, Wise SK, Schlosser RJ. *Otolaryngol Head Neck Surg* (2008).139:137-42.

Endoscopic surgery improves the irrigation of the paranasal sinuses with positive pressure irrigation systems (Sinusalt). Otherwise, pressurized spray systems reach little more than the nasal cavity.

**Effects of buffered 2.3%, buffered 0.9%, and non-buffered 0.9% irrigation solutions on nasal mucosa after septoplasty.** Süslü N, Bajin MD, Süslü AE, Öğretmenoğlu O. *Eur Arch Otorhinolaryngol.* (2008).

Hypertonic solutions used after endonasal surgery are beneficial for improving mucociliary clearance and postoperative decongestion.

**Evaluación de Métodos de Irrigación Nasosinusal en Postoperatorio de C.E.N.S.** Cenjor C, Gutiérrez R, Sanabria J, Márquez F, Martínez D, Pastormeloc G. *Actas del XVII Congreso de la Sociedad Española de Otorrinolaringología y Patología Cérvico facial* (1998), Las Palmas de Gran Canaria, 12-16 Octubre.

Sinonasal irrigation reduce the healing time and facilitate the removal of scabs after endoscopic surgery, having a high degree of acceptance in patients.

**Perioperative Care in Functional Endoscopic Sinus Surgery.** Sonkens JW, Miller RJ, Highlights of The Instructional Courses. *Lucente* (1997) Ed. Ch 24, 267.

Saline irrigation should be done 1 to 3 times a day after endoscopic sinus surgery for enough time to obtain the expected clinical benefits.

**Management of sinusitis in cystic fibrosis by endoscopic surgery and serial antimicrobial lavage. Reduction in recurrence requiring surgery.** Moss RB, King VV. *Arch Otolaryngol Head Neck Surg* (1995) 121:566.

Nasal irrigation is effective for postoperative treatment of sinusitis in cystic fibrosis, reducing recurrences and the need for new surgery.

**Endoscopic Paranasal Sinus Surgery.** Rice D. *Ravens Press* (1993).

Before surgery, saline irrigation is recommended to reduce infection, and after surgery, to restore ciliary function and decrease patient symptoms.

**Surgical approach to tumors of the nasal cavity.** Pope TH Jr. *Laryngoscope* (1978) 88: 1743.

Saline irrigation is very effective to avoid crusting after nasal surgery.

## 5. Irrigation vs. Nebulization/Sprays

**\*Corticosteroid nasal irrigations are more effective than simple sprays in a randomized double-blinded placebo-controlled trial for chronic rhinosinusitis after sinus surgery.** Harvey RJ, Snidvongs K, Kalish LH, Oakley GM, Sacks R. *Int Forum Allergy Rhinol.* 2018;XX:1-10.

In chronic rhinosinusitis disease, the use of corticosteroid delivered by nasal irrigation is superior to simple nasal spray in postsurgical patients.

**A Randomized Controlled Study Comparing the Efficacy of Nasal Saline Irrigation Devices in Children with Acute Rhinosinusitis.** Satdhabudha, A., K. Utispan, P. Monthanapisut and O. Poachanukoon. *Asian Pac J Allergy Immunol* 35, no. 2 (2017): 102-107.

The use of a squeezable bottle for nasal irrigation in children with acute sinusitis was associated with further improvements in sinus symptoms and satisfaction scores compared to syringe use.

**\*\*Update on Intranasal Medications in Rhinosinusitis.** Snidvongs, K. and S. Thanaviratnanich. *Curr Allergy Asthma Rep* 17, no. 7 (2017): 47.

Authors review influence of devices, methods, and patient head position on nasal and paranasal sinus drug delivery.

**Effectiveness of Steam Inhalation and Nasal Irrigation for Chronic or Recurrent Sinus Symptoms in Primary Care: A Pragmatic Randomized Controlled Trial.** Little, P., B. Stuart, M. Mullee, T. Thomas, S. Johnson, G. Leydon, D. Rabago, S. Richards-Hall, I. Williamson, G. Yao, J. Raftery, S. Zhu, M. Moore and Snifs Study Team. *CMAJ* 188, no. 13 (2016): 940-949.

Clinical trial showing that, while nasal irrigation resulted in reduced overall symptom burden, headache, use of over-the-counter medications and the perceived need to consult primary care physicians in future episodes, steam inhalation had no consistent benefits in chronic sinus symptoms.

**Limited Evidence: Higher Efficacy of Nasal Saline Irrigation over Nasal Saline Spray in Chronic Rhinosinusitis--an Update and Reanalysis of the Evidence Base.** van den Berg, J. W., L. M. de Nier, N. M. Kaper, A. G. Schilder, R. P. Venekamp, W. Grolman and G. J. van der Heijden. *Otolaryngol Head Neck Surg* 150, no. 1 (2014): 16-21.



There is a relative effect of nasal saline irrigation and nasal saline spray on subjective symptom improvement in chronic rhinosinusitis.

**Comparison of nasal sprays and irrigations in the delivery of topical agents to the olfactory mucosa.** Lam K. *Laryngoscope* (2013).

Compared to aerosols, nasal irrigation provides a more effective method of administering topical agents to the nasal cavity. The complete distribution of the irrigation has important clinical implications for improved administration of therapeutic agents to the olfactory mucosa.

**Does nasal irrigation enter paranasal sinuses in chronic rhinosinusitis?** Snidvongs K, Chaowanapanja P, Aeumjaturapat S, Chusakul S, Praweswararat P *Am J Rhinol* (2008). 22:483-6.

Small volume nasal spray or nasal irrigation (40 mL) is not able to enter the sinuses in patients with chronic sinusitis.

**Nasal saline for chronic sinonasal symptoms: a randomized controlled trial.** Pynnonen MA, Mukerji SS, Kim HM, Adams ME, Terrell JE. *Arch Otolaryngol Head Neck Surg* (2007). 133:1115-20.

Nasal irrigation performed with large volumes of irrigation fluid is more effective than pressurized sprays for the treatment of sinonasal symptoms.

**Nebulized bacitracin/colimycin: a treatment option in recalcitrant chronic rhinosinusitis with *Staphylococcus aureus*? A double-blind, randomized, placebo-controlled, cross-over pilot study.** Videler WJ, van Drunen CM, Reitsma JB, Fokkens WJ. *Rhinology* (2008).46:92-8.

Nebulization with bacitracin / colimycin is not effective for the treatment of chronic rhinosinusitis.

**A comparative Study of Three Methods of Nasal Irrigation.** Wormald PJ, Cain T, Oates L, Hawke L, Wong I. *Laryngoscope* (2004) 114:2224.

Positive pressure nasal irrigation (SinuSalt) is more effective than nasal sprays or nebulizations to distribute the irrigation solution in the maxillary sinuses and in the frontal recess. This should be the method of choice for the irrigation of these areas.

**Radiographic Comparison of Three Methods for Nasal Saline Irrigation.** Olson DE, Rasgon BM, Hilsinger RL Jr. *Laryngoscope* (2000). 112:1394.

Three methods of nasal irrigation are compared: positive pressure irrigation, negative pressure irrigation (sniffing) and irrigation by nebulization. Among them, the positive irrigation (SinuSalt) is the best one in guaranteeing irrigation to the paranasal sinuses, existing a great difference with nebulizations, whose access to the sinuses is very poor.

**Decontaminating the Nasal Passages.** Berger ME, Jones OW, Ricks RC, Garrett S. *Health Phys* (2003). 84(5 Suppl):S80.

Nasal irrigation is the treatment of choice to decontaminate the nasal cavities from radioactive products, irritants, dust, and pollution in general. Different sinonasal irrigation methods are reviewed.

## 6. Xylitol

**Effect of Postoperative Xylitol Nasal Irrigation on Patients with Sinonasal Diseases.** Kim, D. H., Y. Kim, I. G. Lim, J. H. Cho, Y. J. Park, S. W. Kim and S. W. Kim. *Otolaryngol Head Neck Surg* 160, no. 3 (2019): 550-555.

Xylitol nasal irrigation is useful in postoperative endoscopic sinus surgery and septoplasty care, beyond the benefit provided by normal saline irrigation alone.

**Xylitol Nasal Irrigation in the Treatment of Chronic Rhinosinusitis.** Lin, L., X. Tang, J. Wei, F. Dai and G. Sun. *Am J Otolaryngol* 38, no. 4 (2017): 383-389.

Xylitol nasal irrigation results in greater improvement of symptoms in chronic rhinosinusitis and greater enhancement of nasal nitric oxide in maxillary sinus, as compared to saline nasal irrigation alone.

**Efficacy of nasal irrigations and nebulizations for nasal symptom relief.** Dunn JD. *Curr Opin Otolaryngol Head Neck Surg* (2013),248:51.

Saline irrigation can improve the symptoms of sinonasal disease and may improve outcomes in certain contexts. The use of xylitol in chronic rhinosinusitis seems to be promising.

**European position paper on rhinosinusitis and nasal polyps.** *Official journal of the European and International Societies.* 2012.

Xylitol has been shown to reduce nasal bacterial carriage, otitis media and cavities *in vivo*. Diluted in water, it is a well-tolerated agent for sinonasal irrigation, reducing more efficiently the symptoms of chronic rhinosinusitis compared to saline irrigation alone.

**Xylitol nasal irrigation in the management of chronic rhinosinusitis: a pilot study.** Weissman JD. *Laryngoscope* (2011), 2468:72.

The irrigation with xylitol generates a great improvement of chronic rhinosinusitis symptoms in comparison with saline irrigation alone.

**In vitro susceptibility of established biofilms composed of a clinical wound isolate of *Pseudomonas aeruginosa* treated with lactoferrin and xylitol** Mary Cloud B. Ammons. *International Journal of Antimicrobial Agents* (2009), 230:236.

The combined treatment of lactoferrin and xylitol *in vitro* effectively reduces the viability of *Pseudomonas aeruginosa* isolated from a wound.

**Guía para la aplicación de la legislación de aditivos y contaminantes de la UE en productos pesqueros y acuícolas.** Ministerio de Agricultura, Alimentación y Medio Ambiente. Madrid, 2012.

Xylitol is an authorized additive in processed and unprocessed fishes, mollusks, fish roes and crustaceans.

**Ministerio de Sanidad, Política Social e Igualdad, BOE nº 219 de septiembre de 2011 sobre la lucha contra el dopaje en el Deporte.**

It states that Xylitol is an authorized product in sport first aid kits.

**Reglamento de la Unión Europea nº: 1129/2011.** Diario oficial de la UE. Noviembre de 2011.

It determines that Xylitol is an additive allowed for food use.

**Xylitol enhances bacterial killing in the rabbit maxillary sinus.** Brown CL, *Laryngoscope* (2004), 2021:4.

Xylitol reduces experimental sinusitis when administered simultaneously with bacteria. It may have a role in nasal irrigations for the treatment of human diseases.

**Xylitol in preventing acute otitis media.** Matti Uhari. *Vaccine* (2001), 144:147.

Xylitol, commonly used as food sweetener, seems to offer a possibility to prevent acute otitis media in children, therefore reducing the need for antimicrobial agents.

**The osmolyte xylitol reduces the salt concentration of airway surface liquid and may enhance bacterial killing.** Joseph Zabner. *Proceedings of the National Academy of Sciences of the United States of America* (2000), 11614:9.

Xylitol on the surface of the respiratory tract can improve the innate antibacterial defense and could prevent or delay the onset of bacterial infections in cystic fibrosis patients.

**Antiadhesive effects of xylitol on otopathogenic bacteria.** Tero Kontiokari. *Journal of Antimicrobial Chemotherapy* (1998), 563:565.

Xylitol in chewing gum reduces acute attacks of otitis media by 50%.

**Effect of Xylitol on Growth of Nasopharyngeal Bacteria In Vitro.** Tero Kontiari. *Antimicrobial agents and chemotherapy* (1995), 1820:1823.

Xylitol reduces the growth of *Streptococcus pneumoniae* and *S. mitis*, and could reduce the transport of bacteria, having therefore a clinical importance in the prevention of pneumococcal diseases.

**Xylitol Nasal Irrigation in the Management of Chronic Rhinosinusitis.** Joshua D. Department of Otolaryngology – Head and Neck Surgery Stanford University School of Medicine.

Xylitol is a safe, well-tolerated sinonasal irrigant when mixed with water in a 5% weight / volume formulation.

## 7. Miscellaneous

**A Pilot, Open Labelled, Randomised Controlled Trial of Hypertonic Saline Nasal Irrigation and Gargling for the Common Cold.** Ramalingam, S., C. Graham, J. Dove, L. Morrice and A. Sheikh. *Sci Rep* 9, no. 1 (2019): 1015.

In this pilot study, hypertonic saline nasal irrigation and gargling significantly reduced the duration of upper respiratory tract infections, over-the-counter medications use and illness within the household.

**Budesonide irrigation with olfactory training improves outcomes compared with olfactory training alone in patients with olfactory loss.** Nguyen TP, Patel ZM. *Int Forum Allergy Rhinol.* (2018);00:1–5.

Adding budesonide irrigation to olfactory training significantly improved olfactory ability, compared with olfactory training plus saline irrigation.

**Evaluation of patient nasal saline irrigation practices following endoscopic sinus surgery.** Yoo F, Ference EH, Kuan EC, Lee JT, Wang MB, Suh JD. *Int Forum Allergy Rhinol.* (2017);XX:1–9.

Multiple factors are associated with patient compliance with nasal saline irrigation after functional endoscopic sinus surgery.

**What Is the Best Modality to Minimize Bacterial Contamination of Nasal Saline Irrigation Bottles?** Shargorodsky, J. and A. P. Lane. *Laryngoscope* 125, no. 7 (2015): 1515-6.

Given the potential risk of bottle and irrigant microbial contamination, various approaches for decontamination have been tested and are reviewed.

**Nasal Irrigation: From Empiricism to Evidence-Based Medicine. A Review.** Bastier, P. L., A. Lechot, L. Bordenave, M. Durand and L. de Gabory. *Eur Ann Otorhinolaryngol Head Neck Dis* 132, no. 5 (2015): 281-5.

The present review of the evidence-based literature sought objective arguments for optimization and efficacy of nasal irrigation.

**Clinical Observation and Quality of Life in Terms of Nasal Sinusitis after Radiotherapy for Nasopharyngeal Carcinoma: Long-Term Results from Different Nasal Irrigation Techniques.** Luo, H. H., Z. C. Fu, H. H. Cheng, S. G. Liao, D. S. Li and L. P. Cheng. *Br J Radiol* 87, no. 1039 (2014): 20140043.

The study shows that nasal irrigation is necessary for patients with nasopharyngeal carcinoma for a high quality of life in terms of nasal sinusitis.

**Nasal saline irrigation in children: a study of compliance and tolerance.** Jeffe JS. *Int J Pediatr Otorhinolaryngol* (2012), 409:13.

93% of the children included in the study used nasal saline irrigation and reported symptomatic improvement. Only 28% of parents thought it would be a tolerated treatment by the child. As conclusion, the biggest obstacle to nasal irrigation in children is parents reluctance, showing that regardless of age, the children were judged by the parents.

**Topical antimicrobials in the management of chronic rhinosinusitis: a systematic review.** Lim M, Citardi MJ, Leong JL. *Am J Rhinol* (2008).22 (4):381-9.

This systematic review indicates that antibiotics used topically in nasal irrigation (not in nasal spray) are effective in the treatment of chronic rhinosinusitis.

**Nasal lavage with mupirocin for the treatment of surgically recalcitrant chronic rhinosinusitis.** Uren B, Psaltis A, Wormald PJ. *Laryngoscope* (2008). 118:1677-80.

Nasal irrigation with 0.5% mupirocin is effective for post-surgical treatment of chronic recalcitrant rhinosinusitis.

**Nasal irrigation reduces postirradiation rhinosinusitis in patients with nasopharyngeal carcinoma.** Liang KL, Kao TC, Lin JC, Tseng HC, Su MC, Hsin CH, Shiao JY, Jiang RS. *Am J Rhinol* (2008). 22:258-62.

Sinonasal irrigation is a safe and effective method to reduce post-irradiation rhinosinusitis.

**Evidence-based Recommendations for Antimicrobial Nasal Washes in Chronic Rhinosinusitis.** Elliott KA, Stringer SP. *Am J Rhinol* (2006). 20:1.

Nasal irrigation with antimicrobials is a potential effective treatment for the growing group of patients who remain symptomatic after appropriate medical and surgical treatment.

**Non-invasive Treatment of Intractable Posterior Epistaxis with Hot-water Irrigation.** Schlegel-Wagner C, Siekmann U, Linder T. *Rhinology* (2006). 44:90.

Saline irrigation with hot water is an effective method to reduce posterior nasal hemorrhages.

**New Modification of Hot-water Irrigation in the Treatment of Posterior Epistaxis.** Stangerup SE, Dommerby H, Siim C, Kemp L, Stage J. *Arch Otolaryngol Head Neck Surg* (1999) 125:686.

Saline irrigation with hot water is more effective, less painful and less traumatic to the nose than closing the nostrils for the treatment of posterior nosebleeds. Irrigation also requires a significantly shorter hospitalization time.

**Rhinovirus Infection Induces Mucus Hypersecretion.** Yuta A, Doyle WJ, Gaumond E, Ali M, Tamarkin L, Baraniuk JN, Van Deusen M, Cohen S, Skoner DP. *Am J Physiol* (1998) 274:1017.

The rhinorrhea associated with the common cold leads to a mucoid secretion with infiltration of neutrophils that facilitates bacterial superinfection after some days. Therefore, the elimination of these thick secretions is convenient to reduce superinfections.

**Effect of Nasal Lavage on Nasal Symptoms and Physiology in Wood Industry Workers.** Holmstrom M, Rosen G, Wahlander L. *Rhinology* (1997). 35:108.

Nasal irrigation improved nasal symptoms (obstruction, retronasal secretion, irritation and itching) in workers exposed to sawdust. It also significantly improved peak nasal expiratory flow and mucociliary clearance time.

## 8. Nasal irrigation as vehicle for other drugs and treatments

**Budesonide Nasal Irrigation Improved Lund-Kennedy Endoscopic Score of Chronic Rhinosinusitis Patients after Endoscopic Sinus Surgery.** Huang, Z. Z., X. Z. Chen, J. C. Huang, Z. Y. Wang, X. Li, X. H. Chen, X. P. Lai, L. H. Chang and G. H. Zhang. *Eur Arch Otorhinolaryngol* 276, no. 5 (2019): 1397-1403.

Nasal irrigation improved the prognosis of chronic rhinosinusitis patients after endoscopic sinus surgery. Budesonide nasal irrigation had a better effect than normal saline nasal irrigation.

**Effect of Budesonide Added to Large-Volume, Low-pressure Saline Sinus Irrigation for Chronic Rhinosinusitis: A Randomized Clinical Trial.** Tait, S., Kallogjeri, D., Suko, J., Kukuljan, S., Schneider, J., & Piccirillo, J. F. *JAMA Otolaryngol Head Neck Surg* (2018): 144 (7), 605.

This study shows that budesonide in saline nasal lavage results in clinically meaningful benefits beyond the benefits of saline alone for patients with chronic rhinosinusitis.

**\*Corticosteroid nasal irrigations are more effective than simple sprays in a randomized double-blinded placebo-controlled trial for chronic rhinosinusitis after sinus surgery.** Harvey RJ, Snidvongs K, Kalish LH, Oakley GM, Sacks R. *Int Forum Allergy Rhinol.* 2018;XX:1-10.

In chronic rhinosinusitis disease, the use of corticosteroid delivered by nasal irrigation is superior to simple nasal spray in postsurgical patients.

**The Effects of Nasal Lavage with Betamethasone Cream Post-Endoscopic Sinus Surgery: Clinical Trial.** Dawson, B., I. Gutteridge, A. Cervin and D. Robinson. *J Laryngol Otol* 132, no. 2 (2018): 143-149.

Continued use of betamethasone nasal irrigation remains a viable and safe treatment option for chronic rhinosinusitis patients following functional endoscopic sinus surgery.

**Post-Operative Corticosteroid Irrigation for Chronic Rhinosinusitis after Endoscopic Sinus Surgery: A Meta-Analysis.** Yoon, H. Y., H. S. Lee, I. H. Kim and S. H. Hwang. *Clin Otolaryngol* 43, no. 2 (2018): 525-532.

Although steroid nasal irrigation does not induce adverse events, the beneficial effects of additional steroids in saline irrigation were ambiguous compared with saline irrigation alone. Authors state that further clinical trials are needed.

**The Effectiveness of Budesonide Nasal Irrigation after Endoscopic Sinus Surgery in Chronic Rhinosinusitis with Asthma.** Kang, T. W., J. H. Chung, S. H. Cho, S. H. Lee, K. R. Kim and J. H. Jeong. *Clin Exp Otorhinolaryngol* 10, no. 1 (2017): 91-96.

Nasal irrigation with budesonide is an effective postoperative treatment for chronic rhinosinusitis with asthma, reducing the oral steroid intake.

**Topical Therapies for Refractory Chronic Rhinosinusitis.** Sanan, A., M. Rabinowitz, M. Rosen and G. Nyquist. *Otolaryngol Clin North Am* 50, no. 1 (2017): 129-141.

Chronic rhinosinusitis patients who are recalcitrant to conventional medical and surgical therapies, can benefit from therapies centered on anti-infective and anti-inflammatory nasal irrigations.



**Topical Therapy with High-Volume Budesonide Nasal Irrigations in Difficult-to-Treat Chronic Rhinosinusitis.** Kosugi, E. M., G. F. Moussalem, J. C. Simoes, P. Souza Rde, V. G. Chen, P. Saraceni Neto and J. A. Mendes Neto. *Braz J Otorhinolaryngol* 82, no. 2 (2016): 191-7.

High-volume corticosteroid nasal irrigations are a good option in difficult-to-treat chronic rhinosinusitis control of disease, reaching 81.3% success control and significant improvement.

**\*A prospective randomized blinded clinical trial: large volume nasal irrigation with fluticasone propionate in the early postoperative period following septoplasty.** Tugrul S, Dogan R, Senturk E, Eren SB, Meric A, Ozturan O. *Int Forum Allergy Rhinol.* 2015;5:610–615.

Nasal irrigation with low-pressure, high-volume nasal saline irrigation during the early postoperative period following septoplasty is an effective method, resulting in increased patient satisfaction, nasal air flow and decreased edema and crust formation.

**\*The Use of Large Volume Low Pressure Nasal Saline with Fluticasone Propionate for the Treatment of Pediatric Acute Rhinosinusitis.** Tugrul, S., R. Dogan, S. B. Eren, A. Meric and O. Ozturan. *Int J Pediatr Otorhinolaryngol* 78, no. 8 (2014): 1393-9.

In this study, including ninety-one pediatric patients with acute rhinosinusitis, low pressure nasal saline plus fluticasone propionate is faster than antibiotherapy and nasal decongestant in improving clinical symptoms.

**Topical Drug Delivery for Chronic Rhinosinusitis.** Liang J. and Lane A.P. *Curr Otoehinolaryngol Rep.* (2013) 1(1):51-60.

Devices and pharmaceutical agents to apply topical medical therapy to the sinuses are reviewed. Drug addition to large-volume, low-pressure nasal irrigation can be an effective option for the management of chronic rhinosinusitis.

\*of interest

\*\*outstanding interest